Claims

1. An insulated gate bipolar transistor device (IGBT) comprising: a substrate heavily doped with a first dopant of one polarity;

buffer and drift layers doped with a second dopant of a polarity opposite to the first dopant, the buffer and drift layers located over the substrate, with the drift layer extending to a surface opposite the substrate;

a plurality of base regions doped with the first dopant, each base region bordered by the drift layer, and each base region extending along the length of the surface to form a plurality of base stripes on the one surface of the device;

first and second source stripes doped with the second dopant and located in each base stripe, the source stripes being parallel to each other and extending in the same direction as the base stripes, the source stripes spaced from each other to define a body stripe between the source stripes and spaced from edges of the base stripe to define first and second channel regions extending in opposite directions across opposite edges of the base stripes from each of the source stripes to the nearest border of the drift layer;

a gate oxide stripe over the channels on the surface and a conductive gate stripe on the gate oxide stripe for controlling current through the channels;

an insulating layer over the conductive gate stripes and covering the edges of the source stripes proximate the body stripe;

a source contact layer extending through the insulating layer at a location between opposite gate stripes;

a plurality of source contact regions heavily doped with the second dopant, disposed in the body stripe and extending from the body stripe to at least one of the source stripes and in electrical contact with the source contact layer.

2. The IGBT of claim 1 wherein one or more source contact regions extend from the body stripe in opposite directions to each source stripe.

3. The IGBT of claim 1 wherein the source stripes are continuous along the length of the body stripe.

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4. The IGBT of claim 1 wherein the source stripes are divided into a plurality of elongated source segments spaced from each other along opposite sides of the body stripe, and portions of the body region extending between opposite ends of sequential segments to separate the sequential source stripe segments from each other.

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5. The IGBT of claim 1 wherein the base stripes are connected together to form a common base.

6. The IGBT of claim 4 wherein the source contacts extend from one source segment across the body stripe to the opposite source segment.

7. The IGBT of claim 6 wherein the source contacts extend from the middle of one source segment to the middle of the opposite source segments.

8. The IGBT of claim 4 wherein the source segments are the same length.

9. The IGBT of claim 4 wherein source stripes have forward and rearward ends and the ends of stripes on opposite sides of the body stripe are directly opposite to each other.

10. The IGBT of claim 4 wherein source stripes have forward and rearward ends and the ends of stripes on opposite sides of the body stripe are jogged with respect to each other.

11. The IGBT of claim 4 wherein the source segments are the same length.

12. The IGBT of claim 4wherein the source segments are of different lengths.

13. The IGBT of claim 11 wherein the length of the source segment depends upon its proximity to the center of the IGBT.

14. The IGBT of claim 13 wherein the length of the source segment depends upon a desired local SCIS current density.

15. The IGBT of claim 1 wherein the edges of the source stripes adjacent the body stripe are electrically isolated from contact with the source contact layer.

16. The IGBT of claim 1 wherein doping concentration in the source stripes is the same as the doping concentration in the source contact regions.

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17. The IGBT of claim 1 wherein doping concentration in the source stripes is the less than the doping concentration in the source contact regions.

18. The IGBT of claim 1 wherein the first dopant is p-type and the second dopant is n-type.

19. The IGBT of claim 1 wherein the first dopant is n-type and the second dopant is p-type.

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20. An insulated gate bipolar transistor device (IGBT) comprising:

a substrate heavily doped with a first dopant of one polarity;

a drift layer over the substrate and doped with a second dopant of an opposite polarity, the drift layer extending to a surface opposite the substrate;

base regions doped with the first dopant, each base region bordered by the drift layer and each base region extending along a length of the surface to form a plurality of base stripes on the surface of the device;

source stripes with second dopants in the base regions proximate the border of the base regions to form channel regions extending from the source stripes to the proximate border of the drift layer and the base stripe;

an insulated control gate over the base regions, between the source stripe and the drift layer and over the channel regions;

source contact regions disposed adjacent the source stripes;

resistances disposed between the source contact regions and the source stripes for constricting the flow of electron current between the drift layer and the source contact regions.

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21. The IGBT of claim 20 wherein the source contact regions are spaced from each other along the length of the source stripes to connect opposite stripes to each other only at spaced apart locations and thereby provide the resistances.

22. The IGBT of claim 20 wherein the base regions are connected together to form a common base.

23. The IGBT of claim 20 wherein the source stripes are sequentially segmented and sequential segments are separated from each other by the base region.

24. The IGBT of claim 23 wherein source segments opposite each other are the same length and are connected at their respective middles by an source contact region.

25. The IGBT of claim 23 wherein the sequential segments of opposite source stripes are jogged with respect to each other and are connected together at their opposite, jogged ends by an source contact region.

26. The IGBT of claim 20 wherein the first dopant is p-type and the second dopant is n-type.

27. The IGBT of claim 20 wherein the first dopant is n-type and the second dopant is p-type.

28. An insulated gate bipolar transistor device (IGBT) comprising:

a substrate heavily doped with a first dopant of one polarity;

a drift layer over the substrate and doped with a second dopant of an opposite polarity, the drift layer extending to a surface opposite the substrate;

a trench gate in the surface of the drift layer including a gate insulator on the inside surface of the trench and a conductive material adjacent the gate insulator forming the gate electrode;

base regions doped with the first dopant, each base region divided by the gate trench, bordered by the drift layer and extending along a length of the surface to form a plurality of base stripes on the surface of the device;

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source stripes regions disposed between the base stripes and the trench and shallower than the base for forming channel regions along the outside surface of the trench;

source contact regions extending between the base regions and the source stripes;

a plurality of channel resistances in the source stripes and disposed between the source contact regions;

29. The IGBT of claim 28 further comprising:

a insulating layer over the trench gate and over source stripe regions;

a plurality of vias in the insulating layer and over the source contact regions;

a source contact layer over the insulating layer and extending through the vias therein to contact the source contact regions in the source stripes.

30. The IGBT of claim 28 wherein the source contact regions are spaced from each other along the length of the source stripes to connect the source contact layer to the source stripes only at spaced apart locations and thereby provide the channel resistances.

31. The IGBT of claim 26 wherein the base regions are connected together to form a common base.

32. The IGBT of claim 30 wherein the source stripes are sequentially segmented and sequential segments are separated from each other by the base region.

33. The IGBT of claim 32 wherein source segments opposite each have source contact regions in the middle of the segments.

34. The IGBT of claim 30 wherein the sequential segments of opposite source stripes are jogged with respect to each other and sequential segments on one side of the trench have source contact regions at the heads of the segments and sequential segments on the other side of the trench have source contact regions at the tails of the segments and the heads of the one segments are opposite the tails of the other segments.

35. An insulated gate bipolar transistor device (IGBT) comprising:

a substrate heavily doped with a first dopant of one polarity;

a drift layer over the substrate and doped with a second dopant of an opposite polarity, the drift layer extending to a surface opposite the substrate;

base regions doped with the first dopant, each base bordered by the drift layer and extending along a length of the surface to form a plurality of base stripes on the surface of the device;

two source stripes regions disposed inside each base stripe, the source stripe regions shallower than the base for forming channel regions at a junction of the base stripe and the source stripe;

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source contact regions extending between the base regions and the source stripes;

an insulating layer covering the source stripes and having vias above the source contact regions;

a source contact layer over the source stripes and in the vias for contacting the source contact regions.

a plurality of channel resistances in the source stripes and disposed between the source contact regions;

a gate including a gate insulator and conductive material adjacent the gate insulator forming the gate electrode, said gate disposed over the channel region formed by the base and source stripes.

36. The IGBT of claim 35 wherein the source contact regions are spaced from each other along the length of the source stripes to connect the source contact layer to the source stripes only at spaced apart locations and thereby provide the channel resistances.

37. The IGBT of claim 35 wherein the source stripes are sequentially segmented and sequential segments are separated from each other by the base region.

38. The IGBT of claim 35 wherein the base regions are connected together to form a common base.

39. The IGBT of claim 37 wherein source segments opposite each have source contact regions in the middle of the segments.

40. The IGBT of claim 34 wherein the sequential segments of opposite source stripes are jogged with respect to each other and sequential segments on one side of the trench have source contact regions at the heads of the segments and sequential segments on the other side of the trench have source contact regions at the tails of the segments and the heads of the one segments are opposite the tails of the other segments.

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41. The IGBT of claim 32 wherein the gate is a planar gate on the surface of the IGBT over the base region.

42. The IGBT of claim 32 wherein the gate is a trench gate extending from the surface into the base region.